

Puget Sound Naval Shipyard & Intermediate
Maintenance Facility

~~PSNS~~ Dry ~~dock~~ Dock Discharge Dye Study ~~Dye~~
~~Release Sampling Plan~~

September ~~DRAFT~~
~~8-16-22~~ ~~March~~ 2004

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Project ENVVEST

Executive Summary

This document describes results of a dye release study performed at Puget Sound Naval Shipyard & Intermediate Maintenance Facility performed in April 2004.

The goal of the study was to measure the amount and spatial extent of dilution of dry dock discharge water when mixed into adjacent Sinclair Inlet waters under a nominal normal operational conditions.

The approach taken was to add known amounts of fluorescent dye to dry dock discharges and measure its concentration once it is mixed with the adjacent receiving waters. Dye measurements were made at a fixed point near to the discharge point to determine the minimum dilution in the plume. The spatial distribution of dye was also mapped as a function of time to assess the full spatial extent of mixing over a range of tide conditions.

Normal dry weather discharge of ground water mixed with dye from dry docks 6 and 4 was successfully mapped in the adjacent inlet waters during both flood and ebb tide conditions. The discharge plumes rose to the surface relatively quickly after leaving the discharge pipe because of their lower density relative to the surrounding inlet water. Plume water reached the surface within several meters of its discharge from Pump Well 6 underneath pier 9. The plume surfaced about 30 m out from quay wall (~40 m from the end of pipe) from Pump Well 4. The increased distance away from Pump Well 4 was presumably a result of a higher discharge velocity through a special check valve unit.

At Pump Well 6, the "boil" region was diluted by only a factor of 1.5 whereas the boil off Pump Well 4 was diluted by a factor of 7. However, there was a relatively quick and efficient mixing of the plumes at both locations once they reached the surface. Background levels were typically reached within 100 m or so of where the plumes surfaced. Dilution factors of between 100 and 1000 were reached while still within the confines of shipyard security boundary off Pump Well 6 and well within the confines of the piers off Pump Well 4. Average dilution factors in the boxed areas outside each outfall (**Error! Reference source not found.** and **Error! Reference source not found.**) ranged between 200 and 1000.

While there was clearly some advective flow that mixed the plumes out from the "boil" region, the majority of the mixing occurred while spreading at the surface. In some instances the advective flow resulted in patchiness of the distribution but the principal variability in the spatial distributions was a result of sampling at different stages in the pump cycle rather than tidal flow. There was a slight buildup in background levels of dye with successive pump cycles in the immediate region of the surface "boil" though there was no clear relationship between tide stage and the build up.

The study data should prove useful in validating numerical plume models that can be used to address a variety of discharge and tidal conditions at these locations. The results should provide support in developing appropriate National Pollutant Discharge Elimination System permit limits for these discharges.

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